

# PATENT APPLICATION TRANSMITTAL LETTER

Our Docket No. C1190/20006

The Assistant Commissioner For Patents:

Transmitted herewith for filing under 35 U.S.C. 111 and 37 CFR 1.53 is the patent application of: Didier COLAVIZZA and Renaud DENIAUD, entitled: NEW BAKER'S YEASTS AND STRAINS FOR THEIR PREPARATION

## Enclosed are:

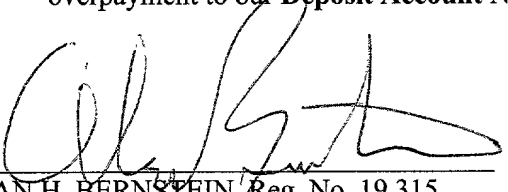
- ☒ 24 pages of written description, claims and abstract.
- ☒ 1 sheets of drawings.
- ☐ assignments of the invention to \_\_\_\_\_
- ☐ recordation sheet for assignment (in duplicate)
- ☐ executed declaration of the inventor(s) and power of attorney.
- ☐ certified copy of a \_\_\_\_\_ application.
- ☐ verified statement to establish small entity status under 37 CFR 1.9(f) and 1.27(b) - Independent Inventor.
- ☐ verified statement to establish small entity status under 37 CFR 1.9(f) and 1.27(c) - Small Business Concern.
- ☐ information disclosure statement.
- ☐ preliminary amendment.
- ☒ other: cover sheet, Express Mailing sheet, and return receipt post card

## CLAIMS AS FILED

	Number Filed	Number Extra	Rate	Fee
BASIC FEE			\$710.00	\$ 710.00
TOTAL CLAIMS	27 - 20 =	*7	x 18	126
INDEPENDENT CLAIM	10 - 3 =	7	x 80	560
MULTIPLE DEPENDENT CLAIM PRESENT			\$270.00	270

*Number Extra Must Be Zero or Larger	TOTAL	\$ 1,666.00
If Applicant has small entity status under 37 CFR 1.9 and 1.27, then divide total fee by 2 and enter amount here	SMALL ENTITY TOTAL	\$

- ☒ The Commissioner is hereby authorized to charge \$1,666.00 to cover the payment of the filing fee to our **Deposit Account No. 03-0075** (duplicate attached).
- ☒ The Commissioner is hereby authorized to charge any deficiency in the payment of the required fee(s) or credit any overpayment to our **Deposit Account No. 03-0075**.

  
 ALAN H. BERNSEIN, Reg. No. 19,315  
 CAESAR, RIVISE, BERNSTEIN,  
 COHEN & POKOTILOV, LTD.  
 12<sup>th</sup> Floor - 7 Penn Center /1635 Market Street  
 Philadelphia, PA 19103-2212 (215) 567-2010

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Attorney Docket No. C1190/20006

Applicants : Didier COLAVIZZA and Arnaud DENIAUD

For : NEW BAKER'S YEASTS AND STRAINS  
FOR THEIR PREPARATION

This is a patent application, which includes the following:

1. Description - 17 pages
2. 22 Claims - 6 page
3. Abstract of the Disclosure - 1 page
4. 1 sheet Drawing
5. Cover sheet
6. Patent Application Transmittal Letter, in duplicate
7. Return Receipt Post Card

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Robert Fidler

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
APPLICATION FOR LETTERS PATENT

Applicants : Didier COLAVIZZA and  
Arnaud DENIAUD

Addresses : 1 rue Berthelot  
59163 Conde Sur L'Escaut  
FRANCE

12 rue des Barrières  
59700 Marcq en Baroeul  
FRANCE

Invention : NEW BAKER'S YEASTS AND STRAINS  
FOR THEIR PREPARATION

Attorneys : CAESAR, RIVISE, BERNSTEIN,  
COHEN & POKOTILOV, LTD.  
(Registration No. 14,129)  
12th Floor, Seven Penn Center  
1635 Market Street  
Philadelphia, PA 19103-2212

TO ALL WHOM IT MAY CONCERN:

Be it known that we, Didier Colavizza and Arnaud Deniaud, are citizens of France, residing in Conde Sur L'Escaut, France, and Marcq en Baroeul, France, respectively, have made a certain new and useful invention in NEW BAKER'S YEASTS AND STRAINS FOR THEIR PREPARATION, of which the following is a specification.

## NEW BAKER'S YEASTS AND STRAINS FOR THEIR PREPARATION

The invention relates to new baker's yeasts or bread-making yeasts. It also relates to strains for the preparation of said baker's yeasts.

In the USA, the trade of frozen doughs, notably of sweet doughs such as frozen doughs intended for bakery products called "Rolls" or for Danish sweet pastries or for similar sweet fermented and baked products is quickly expanding ; however, freezing involves an important stress for the yeast.

In the USA, small breads or fermented pastries are very often aromatized (flavored) with cinnamon ; this spice contains cinnamic acid and cinnamaldehyde ; these chemical compounds can be metabolized by yeasts which leads to the appearance of bad taste and of bad flavors, also called "off-flavors".

Are already known baker's yeasts which are resistant to the stress caused by freezing or deep-freezing and which can be used in frozen doughs without the necessity to increase in an important extent the amount of yeast, increase which is necessary when using conventional baker's yeasts which are not resistant to said stress. Baker's yeasts resistant to freezing have been developed in Europe and in Japan.

Also known are baker's yeasts which can be used without formation of off-flavors, in the manufacture of bakery products comprising cinnamon. Such baker's yeasts, which do not give rise to the appearance of off-flavors in the presence of cinnamon are commonly marketed in the USA.

The new baker's yeasts which the applicants had the merit of having developed have the properties of the two types of baker's yeasts here-above discussed.

These new baker's yeasts are characterized by the fact that :

- they have good general performances in not delayed bread-making processes, i.e. in bread-making processes which do not comprise a freezing or deep freezing step,
- they are resistant to the stress caused by freezing when they are used in sweet doughs and,
- they do not give rise to the appearance of bad taste or of off-flavors in the presence of cinnamon.

Indeed this property of not giving rise to the appearance of bad taste or of off-flavors is essential for a baker's yeast and must be verified in any breadmaking process wherein the said baker's yeast is intended to be used.

In the tests A<sub>1</sub>, A<sub>5</sub> and A<sub>6</sub> carried out with the fermentometer of Burrows and Harrison and which are described in column 5 of US patent No. 5,741,695 of April 21, 1998, the entire disclosure of which is incorporated by reference, the said good general performances in not delayed bread-making processes obtained with the said new baker's yeasts lead to the following gas releases:

- in test A<sub>1</sub>, at least 150 ml in 2 hours,
- in test A<sub>5</sub>, at least 90 ml in 2 hours,
- in test A<sub>6</sub>, at least 80 ml in 2 hours.

In other words, these new baker's yeasts are characterized by the fact that in not delayed bread-making processes, they give rise in the fermentometer tests A<sub>1</sub>, A<sub>5</sub> and A<sub>6</sub> carried out with the fermentometer of Burrows and Harrison to gas releases which are at least equivalent with those obtained with a control yeast produced according to a conventional process starting from the strain deposited at the "Collection Nationale de Cultures de Microorganismes" (CNCM), Institut Pasteur under the number CNCM I-2412, said strain being representative of the strains commonly used in the USA for the manufacture of baker's yeasts.

A conventional process of baker's yeast manufacture is a process described in the chapter 6 "Baker's Yeast Production" of the handbook "Yeast Technology", Second Edition, Reed and Nagodawithana, An Avi Book published by Van Nostrand Reinhold, 1991.

The resistance toward the stress caused by freezing of the new baker's yeasts according to the invention is characterized:

- on the one hand by the fact that, when used in doughs corresponding to formulations of sweet Danish pastries i.e. to doughs comprising about 18% sugar (sucrose) by weight with respect to the flour used and comprising fats, the total gas releases recorded after freezing and thawing of the said doughs after at least 100 days are higher by at least 20 %, preferably by at least 30 % and still more preferably by at least 40 % than the total gas releases recorded under the same

conditions when using a control yeast obtained conventionally starting from a control strain such as the strain CNCM I-2412,

- on the other hand by the fact in the above-defined use, the proof time of the said sweet Danish pastry dough, frozen and thawed after at least 100 days, is lower by at least 10 %, preferably by at least 15 % and still more preferably by at least 20 % than that measured under the same conditions when using the above-defined conventional control yeast.

Indeed in these comparisons the control yeast must be under the same form than the new baker's yeast tested.

Preferably, the said total gas releases on the dough pieces are measured using the zymotachygraphe CHOPIN® during 2 hours and 30 minutes at 27°C and the proof times are measured at 35°C.

It is recalled that the proof time is according to the handbook of basic technical baking terminology by E.J. Pyler used as reference the length of time for which a moulded dough piece is held in the final proofer prior to baking so it can attain the desired degree of aeration or volume increase.

It is recalled that the zymotachygraphe CHOPIN® or CHOPIN® zymotachygraphe is a conventional apparatus known to those skilled in the art for measuring the gaseous release of a dough ball or piece. This apparatus is notably described in a detailed manner in chapter VII B "Appreciation du pouvoir fermentaire" (appreciation of the fermenting power), §6.5 "Le Zymotachygraphe" (CHOPIN, 1973), pages 461 to 463 in the manual "Guide pratique d'analyses dans les industries des céréales", B. Godon and W. Loisel, Technique et Documentation (Lavoisier) 1984, ISBN 2-85206-081-7 Collection 2-85206-230-5. The fermentometer of Burrows and Harrison is the object of §6.1 of this Chapter VIIB, pages 454 to 460.

For the preparation of the new baker's yeasts according to the invention, it is possible to use two strains which were deposited on the 24<sup>th</sup> March 2000 according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes" (CNCM), Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, FRANCE, under the numbers:

I-2421 (strain L17)

I-2422 (strain L35).

Strain now called L17 in reason of its possible industrial use and deposited under the number CNCM I-2421 had been cited in a different context in US patent No. 5,741,695, but the said strain had been considered at that time as presenting no interest as a baker's yeast strain due to its too high invertase content. It has not been deposited before the 24<sup>th</sup> March 2000 with a Public Culture Collection Center (deposit according to the Budapest Convention). It has always been kept in the private and confidential collection of the Lesaffre Group in its research laboratories located at 59700 Marcq-en-Baroeul in France without being commercially or publicly used and without being accessible to third parties. Consequently, this strain is a novel baker's yeast strain.

Strain L35, deposited under the number CNCM I-2422 was obtained by mutation starting from strain L17; that strain has never been cited in a prior art document, and is also a novel baker's yeast strain.

These two strains were selected from a great number of strains among especially the strains of the private collection of the Lesaffre Group using three series of systematical selection tests. The confidential and private collection of the Lesaffre Group contains numerous strains which were constructed, notably according to the reproducible construction processes of new strains disclosed by the US patents Nos. 4,396,632 and 5,741,695. The entire disclosure of these two US patents is incorporated herein by reference.

In these different series of tests, the control strain is the one which was deposited with the "Collection Nationale de Cultures de Microorganismes", under the number I-2412. That strain is representative of the strains which are commonly used in the USA for the manufacture especially of baker's yeasts intended for the breadmaking of products of the sweet roll type and of Danish pastries.

That control strain and the various tested strains had been cultivated on cane molasses in pilot installations. The scheme of the cultivation on cane molasses, used here, is the one disclosed in example 3 of US patent 5,741,695 from line 40, column 12, to line 26, column 13. It has permitted to obtain fresh baker's yeasts having a dry matter content of about 32%. The nitrogen content with respect to the dry matter of these fresh yeasts is adjusted between about 8.2% and about 8.5%.

In a first time, the first selection test consists in searching the various fresh baker's yeasts obtained with the various tested strains that give rise in tests A<sub>1</sub>, A<sub>5</sub>

and  $A_6$  carried out with a fermentometer of Burrows and Harrison as disclosed column 5 of the US patent No. 5,741,695 which is incorporated herein by reference, to results which are at least 150 ml in test  $A_1$  in two hours, at least 90 ml in test  $A_5$ , in two hours and at least 80 ml in test  $A_6$ , in two hours.

It is being recalled that all these results, in absolute value, concerning gas releases or proof times, must always be compared with respect to at least a control. As a matter of fact, the principles indicated in example 6 of US patent 5,741,695, columns 19 and 20, and especially column 20, lines 50 to 57 have a general value.

Then, the second systematical selection test consists in the examination from the point of view of their behavior with respect to cinnamon, of fresh yeasts issued from the first selection test, i.e. fresh yeasts, which, in the tests  $A_1$ ,  $A_5$  and  $A_6$ , give at least the hereabove defined results.

In that connection, quantities of 150 mg of dry matter of each of the said fresh baker's yeasts are used in order to ferment during 4 hours at 30°C, 20 ml of each of two sweet nutrient solutions under weak agitation in 125 ml flasks not hermetically closed. The nutrient solution, buffered to pH 5.5, contains in a total volume of 1000 ml: 4.7 g  $(\text{NH}_4)_2\text{HPO}_4$ , 2 g  $\text{Mg SO}_4 \cdot 7\text{H}_2\text{O}$ , 0.8 g KCL, 10 ml vitamins solution and 150 ml citrate buffer. The 10 ml solution of vitamins contains 4 mg thiamin (B1 vitamin), 4 mg pyridoxyn (B6 vitamin) and 40 mg nicotinic acid. The 150 ml citrate buffer contains 14.14 g of trisodium citrate and citric acid necessary to adjust the pH to 5.5. The first sweet nutrient solution or control solution consists of the said nutrient solution to which is added 6% of sorbitol, 0.25% of yeast extract and 6% of glucose. The second sweet nutrient solution consists of the said nutrient solution to which is added 6% of sorbitol, 0.25% of yeast extract, 6% of glucose and 0.04% of cinnamic acid. The percentages are expressed in weight with respect to the total or final volume of sweet nutrient solutions.

The test consists in the comparison of the odor of the solution fermented without cinnamic acid with that of the solution fermented in the presence of cinnamic acid. This test of comparison of odors, based on the detection of off flavors due to the decomposition of cinnamic acid is made on the basis of notes given by a jury. The notes given by the jury can be confirmed by analyses of the decomposition rate of cinnamic acid, i.e. by the determination of the cinnamic acid still present at the end of



the test and/or by the determination of styrene present in the solution fermented in the presence of cinnamic acid.

Cinnamic acid and styrene can be dosed by chromatographic methods known to those skilled in the art in the fermented solutions centrifuged at 4°C in order to remove yeast cells. The cinnamic acid can be dosed by reverse phase HPLC (High Performance Liquid Chromatography) on C18 column, the elution being realized by a gradient of acetonitrile between 10% and 40% in water, in presence of 0.1% of trifluoroacetic acid (percentages volume/volume), the detection being realized by an U.V. detector at 260 nm. The styrene can be dosed by gas chromatography coupled with mass spectrometry. The styrene was dosed in a VARIAN® GC 38000 gas chromatograph equipped with column CHROMPACK® CP-Wax 52 CB 30m\*0.25mm, df:0.5µm. The sampling methods used was static headspace, 3 g of supernatant being placed into 10 ml glass vials which are heated at 35°C with agitation for the timed equilibrium step (15 min), the headspace volume of 100 µl being injected into the GC column. The oven temperature of the chromatograph was programmed as follows: 2 min isotherm at 55°C, heated at 5°C/min up to 230°C. Helium was used as carrier gas with a flow rate of 1 ml/min. The styrene was detected by mass spectrometry SATURN 2000 VARIAN®.

This second test shows that most of the baker's yeasts used in Europe, and especially the baker's yeasts which in Europe are considered as efficient on frozen doughs, give rise to the appearance of off-flavors in the presence of cinnamic acid.

At the end of this second test, only are selected baker's yeasts which do not give rise to the formation of off-flavors. Notably, baker's yeasts obtained from the strain L17 (CNCM I-2421) and from the strain L35 (CNCM I-2422) pass successfully this second test.

The control baker's yeast obtained starting from the strain CNCM I-2412 does not give rise to the formation of off-flavors in that test.

The strains CNCM I-2412, CNCM I-2421 and CNCM I-2422 being three examples of strains which pass successfully this test, consequently they permit to calibrate this biological test by comparison.

The thus selected strains through the hereabove defined baker's yeast selections are then subjected to a third series of selection tests which consist in the determination of their resistance against the stress caused by freezing, in other

words their qualification for the preparation of baker's yeasts which can be used in the manufacture of frozen dough pieces intended for sweet rolls and for sweet Danish pastries.

The compositions of the sweet rolls and the sweet Danish pastries used in that series of tests are as follows:

1) Rolls containing 6 % of HFCS (high fructose corn syrup) dry matter or 10 % of sucrose:

- flour	100.0
- water	55.0 %
- yeast expressed in dry matter	1.86 %
- HFCS expressed in dry matter	6.0 %
	(or sucrose 10.0 %)
- fats	5.0 %
- salt	2.0 %
- dough improver	2.0 %

2) Sweet Danish pastries:

- flour	100.0
- water	46.0 %
- yeast expressed in dry matter	2.72 %
- sucrose	18.0 %
- fats	13.0 %
- pulverulent lactoserum	4.0 %
- salt	2.0 %
- dough improver	2.0 %

The percentages are expressed in what is called "baker's percent", that is to say in weight with respect to 100 parts of the total flour used.

The flour used is a US flour having a high gluten content well adapted to bread-making comprising a deep-frozen step.

The dough improver used for the rolls and for the Danish pastries brings gluten, diacetyltartaric esters of monoglycerides (DATEM), ascorbic acid, alpha-amylases and hemicellulases, in amounts permitting to obtain optimized dough pieces for deep frozen and long storages at -20°C.

The conditions of the manufacture of the frozen doughs intended for rolls and for Danish pastries, those of the storage of the frozen doughs until thawing of the frozen doughs and those of the tests to which are subjected the dough pieces are as follows:

- mixing,
- temperature of the dough at the end of mixing: 19°C,
- separation in balls of 100 g, in a room whose temperature is 19°C,
- beginning of deep-freezing 35 minutes after the end of mixing,
- deep-freezing during 35 minutes at -30°C which provides a temperature at the center of dough pieces of -5°C,
- storage at -20°C during 100 days,
- thawing within 20 hours at 0°C at the end of each of the storages of 100 days,
- determination after thawing of the total gas release using the zymotachygraphe Chopin® during 2 hours and 30 minutes at 27°C,
- proofing and measuring of the proof time at 35°C on three dough pieces or balls,
- baking and appreciation of volume and of the scoring of obtained rolls or pastries and notably verification of the absence of any bad taste or any off-flavors.

Within the framework of these tests, baker's yeasts were selected which provided dough pieces of sweet Danish pastries obtained as here-above disclosed and thawed after 100 days at - 20°C, which showed the following performances:

- total gas release measured using a zymotachygraphe CHOPIN® in 2 hours and 30 minutes at 27°C at least higher by 20 % with respect to that of the pieces obtained under the same conditions using the control yeast conventionally manufactured starting from the strain CNCM I-2412 and stored in the same manner,
- proof time lower by at least 10 % with respect to that of dough pieces obtained and stored under the same conditions but using the control yeast,
- absence of any bad taste or any off-flavors.

The tests carried out with the dough pieces corresponding to the formulations of sweet rolls permit to confirm the selection because they permit to verify that the searched differences are also obtained with a wide range of sweet pastries.

The two strains selected at the end of these three systematical selection tests are the two strains here-above identified, i.e. the strains deposited at the CNCM under the numbers I-2421 and I-2422.

These two strains have been selected because the yeasts manufactured starting from these strains gave rise with respect to the control yeast to the greatest differences in all the tests of frozen and thawed doughs.

The yeasts obtained with these two selected strains permitted to obtain frozen sweet Danish pastry pieces which, when thawed after 100 days at - 20°C, provided a total gas release which was higher by at least 30 % when measured with the zymotachygraphe CHOPIN® and a proof time lower by at least 20 %, in fact by 25 %, with respect to the control yeast used under the same conditions.

These two strains permit to obtain yeast creams and fresh yeasts which show a good aptitude to keep their properties during storage. These two selected strains CNCM I-2421 and I-2422 also present the interesting properties consisting in the fact that they are responding well to cultivation processes with discontinuous inflow of molasses as those disclosed in the UK patent No. 1,539,211 or US patent No. 4,328,250 with the view of improving the performances of the yeasts on sweet doughs and especially in the fact that they are keeping these higher performances on sweet dough, due to the use of the said cultivation processes, in sweet dough pieces thawed after several months of storage at - 20°C. Preferably, the baker's yeasts according to the invention are obtained using such kind of cultivation processes of adaptation to the fermentation of sweetened doughs.

These two strains CNCM I-2421 and I-2422 also have the property to give frozen intermediate dry yeasts the use of which is particularly interesting for the making of sweet frozen doughs.

The frozen intermediate active dry yeasts are defined as frozen dry yeasts in the form of particles, having an intermediate dry matter, i.e. a dry matter content of from 70 to 80% in weight, preferably 72 to 78%, still preferably 74 to 78%. The said frozen intermediate active dry yeasts can be made as described in European patent No. 0237427 B2 corresponding to Canadian patent No. 1,299,435 or corresponding to Australian patent No. 609 030 (document No. AU-B-69781/87), the entire disclosures of which are incorporated by reference.

Different trials carried out with strain CNCM I-2421 cultivated according to a process with discontinuous inflow of molasses during the whole or part of the last cycle of multiplication, have led to frozen intermediate dry yeasts between 70 and 80 % dry matter, preferably between 72 and 78 % dry matter, giving the following gas releases in tests A<sub>1</sub>, A<sub>5</sub>, A<sub>6</sub> described in US patent No. 5,741,695:

test A<sub>1</sub> 170 ml to 190 ml in two hours

test A<sub>5</sub> 110 ml to 130 ml in two hours

test A<sub>6</sub> 115 ml to 140 ml in two hours.

In these tests A carried out with frozen intermediate active dry yeasts, the 160 mg of yeast solid content (tests A<sub>1</sub> or A<sub>5</sub>) or the 320 mg of yeast solid content (test A<sub>6</sub>) of frozen intermediate dry yeast are thawed during one hour at room temperature before being mixed with the 15 ml of water as described column 5 of US patent No. 5,741,695.

These two strains CNCM I-2421 and I-2422 can be characterized using the identification technique of yeast strains using the Polymerase Chain Reaction and based on the amplification of the inter delta zones of the retrotransposon TY1, and which is disclosed in the Article "Identifications of Yeast Strains Using the Polymerase Chain Reaction" by F. Ness, F. Lavallée, D. Dubourdieu, M. Aigle and L. Dulau, published in J. Sci. Food Agric. 1993, 62, 89-94.

In that respect it appears from the single figure or figure 1 which shows in 1, 2 and 3 the electrophoresis profiles of amplified DNA sequences of strains L17 and L35 and a profile of digested DNA used as a molecular weight marker, that the strain L17 (CNCM I-2421) presents two supplemental bands with respect to the strain L35 (CNCM I-2422). Taking into consideration the above-indications, it appears that the invention relates as a new industrial product not only to the baker's yeasts here-above defined but also to the strains deposited under the numbers CNCM I-2421 and I-2422.

The invention also relates on the one hand to the use of the two strains CNCM I-2421 and CNCM I-2422 and on the other hand to the use of similar strains to these two strains, for the preparation of baker's yeasts according to the invention in the form of yeast creams, fresh compressed yeasts and active dried yeasts, preferably in the form of frozen intermediate active dry yeasts. It relates also to the new baker's yeasts able to be thus obtained. Similar strains to the two strains CNCM

I-2421 and CNCM I-2422 are defined as the strains sharing all the common properties to these two strains and/or as the strains able to be selected by the three series of systematical selection tests hereabove disclosed, i.e. the baker's yeast strains which pass successfully the said three systematical selection tests.

As already indicated, baker's yeast strains which have the property to be resistant to the stress caused by freezing were known, but these baker's yeast strains cannot be used without formation of off-flavors in the manufacture of bakery products containing cinnamon.

This default can be corrected and is corrected by the deletion or disruption or inactivation in the genome of said baker's yeast strains of the PAD1 gene(s) encoding phenylacrylic acid decarboxylase, the enzyme which permits the decomposition of cinnamic acid.

The PAD1 gene is described and characterized entirely by Clausen et al. (1994), Gene 142: 107-112 in an article entitled "PAD1 encodes phenylacrylic acid decarboxylase which confers resistance to cinnamic acid in *Saccharomyces cerevisiae*." This PAD1 gene is also called Phenolic Off Flavors gene or POF gene.

Such a targeted inactivation of the PAD1 gene can be obtained by conventional gene replacement methods (see Rothstein in Guthrie C. and Fier GR (editors) Guide to Yeast Genetics and Molecular Biology in Methods in Enzymology vol. 194: 281-301) or by employing an integration/excision DNA cassette as described in the European patent application No. 0 994 192 or in the corresponding US patent application Serial No. 09/415,216 filed on October 12<sup>th</sup>, 1999 and having as title "Yeast transformation cassette" or still the Australian patent application No. 53572/99, the entire disclosures of which are incorporated by reference.

These patent applications which are incorporated by reference disclose integration/excision DNA cassettes which permit the total or partial deletion of a same gene in *Saccharomyces cerevisiae*, leaving in the host strain only yeast DNA. In order to disrupt the PAD1 gene(s), it is constructed integration/disruption cassette(s) CAS-PAD on the same principle of the integration/disruption cassettes CAS-SUC disclosed in the example 4 of these patent applications and the said cassette(s) CAS-PAD are used to delete or disrupt the alleles of the PAD1 gene by integration(s)/excision(s) as disclosed in the said example 4. This strategy consisting in the use of the said integration/excision DNA cassette(s) is preferred by the

applicants as it allows to inactivate all copies of the PAD1 gene in a strain containing more than one copy as it is often the case for industrial strains. In addition, this strategy leads to the construction of strains, in which the selectable marker has been eliminated.

5 This elimination of the selectable marker is very important. Today no baker's yeast is obtained by multiplication of a genetically modified strain and it is generally admitted that only a genetically modified strain stable and without selectable marker could be acceptable as baker's yeast strain.

10 The invention relates to the new baker's yeast strains obtained (or modified) by clean deletion of the PAD1 gene(s) encoding phenylacrylic acid decarboxylase. A clean gene deletion or inactivation is defined as a genetical modification which cuts out the expression of the deleted or inactivated gene(s) (i.e. in the frame of present invention the PAD1 gene(s)), without leading to the expression of a heterologous gene, and preferably without leading to the production of any new compound toward a natural yeast mutant strain which has its said gene(s) disrupted or inactivated.

15 Another preferred strategy in order to obtain baker's yeast strains which have their gene(s) PAD1 inactivated, consists in mutating baker's yeast strains intended to be modified, by a classic mutagenic treatment giving a cell survival ratio of about 20 to 30% and selecting in a first time the mutated strains which show no any phenylacrylic acid decarboxylase activity in the presence of cinnamic acid and/or ferulic acid and/or coumaric acid, and notably which show no production of off-flavors (volatile phenols and/or styrene). In a second time, it is verified on the selected mutated cells presenting this property, the no-expression of gene(s) PAD1 by conventional technics as Northern hybridization (described in Molecular Cloning, a laboratory manual, second edition, Sambrook, Fritsch, Maniatis); and it is verified that the said mutated (mutant) strains not expressing their gene(s) PAD1 have kept the whole of their interesting properties as baker's yeast strains.

25 Preferably the invention relates to baker's yeast strains resistant to the stress caused by freezing and modified by clean deletion (disruption) of the PAD1 gene(s). The starting or host strains are known baker's yeast strains resistant to the stress caused by freezing, as the baker's yeast strains giving the European baker's yeasts performing on frozen doughs cited hereabove, the said baker's yeast strains being modified by clean deletion of the PAD1 gene(s). Still preferably, the said starting or

host known baker's yeast strains selected in order to be modified by clean deletion of the PAD1 gene(s) contained in their genome, pass successfully the first selection test and the third series of selection tests hereabove disclosed, and the modified strains pass successfully the three series of selection tests hereabove disclosed.

5 Indeed, the invention relates also to the same or equivalent baker's yeast strains obtained by mutation the gene(s) PAD1 of which is(are) inactivated. Indeed, the said mutation process leads to a clean inactivation as hereabove defined. Indeed, the invention relates to all the new baker's yeast strains obtained by clean inactivation of their PAD1 gene(s) whatever the used mean of inactivation.

10 The invention relates also to new baker's yeasts having the new properties hereabove disclosed, obtained by a process comprising the use of any of the said new modified or mutated baker's yeast strains hereabove disclosed. In a general manner, the invention relates to the use of the hereabove disclosed modified or mutated baker's yeast strains, obtained by inactivation of the PAD1 gene(s), for the preparation of baker's yeasts in the form of yeast creams, fresh compressed yeasts, frozen intermediate active dry yeasts, and active dry yeasts.

15 Still, in a general manner, the invention relates to a process for the preparation of new baker's yeasts according to the invention comprising the conventional cultivation or multiplication of a selected starting strain. Preferably, the new baker's yeasts according to the invention are obtained by the use of a special cultivation process corresponding to a fed-batch process comprising a discontinuous inflow of molasses during the whole or part of the last cycle of cultivation. The invention has also as object new baker's yeasts having the new properties hereabove disclosed and obtained or able to be obtained by a process comprising a discontinuous inflow of molasses during the whole or part of the last cycle of cultivation.

20 Preferably the said selected starting strain is strain CNCM I-2421 or I-2422, but the said selected strain can be also a similar strain to strains CNCM I-2421 and CNCM I-2422, i.e. a strain sharing all the common properties to these two strains and/or able to be selected as hereabove disclosed, or also a baker's yeast strain obtained by clean inactivation of the PAD1 gene(s).

25 The invention also relates to new frozen intermediate active dry yeast products, having between 70 and 80% dry matter, preferably between 72 and 78%



dry matter, still preferably between 74 and 78% dry matter. The said frozen intermediate active dry yeasts are preferably in the form of rod shaped flowing particles of a diameter less than 3mm, preferably less than 1mm, and they are preferably obtained by a gentle drying of a fresh baker's yeast (i.e. a baker's yeast between about 30% and about 35% dry matter) until the desired dry matter and a freezing by fluidization. The said frozen intermediate active dry yeasts have preferably the following properties:

- very good performances in tests A carried out with the fermentometer of Burrows and Harrison, i.e.

in test A<sub>1</sub> gas release between 170 ml and 190 ml in two hours

in test A<sub>5</sub> gas release between 110 ml and 130 ml in two hours

in test A<sub>6</sub> gas release between 115 ml and 140 ml in two hours.

- they are resistant to the stress caused by freezing when they are used in sweet frozen doughs, i.e. when they are used for the making of sweet Danish pastry doughs comprising 18% sucrose with respect to the flour used and comprising fats, the following characteristics are obtained:

on the one hand, the total gas release recorded with the zymotachygraphe Chopin® on a dough piece frozen and thawed after at least 100 days is higher by at least 20% than the total gas release recorded under the same conditions when using the same amount of yeast dry matter of a conventional control fresh yeast obtained starting from strain CNCM I-2412

on the other hand, the proof time of the said sweet Danish pastry doughs, frozen and thawed after at least 100 days is lower by at least 10% than that measured under the same conditions when using the same amount of yeast dry matter issued of the said conventional control fresh yeast.

- they do not give rise to the appearance of bad taste or of off-flavors in the presence of cinnamon.

The said new frozen intermediate active dry yeasts in fine free flowing particles can contain free flowing agents or anticaking agents as silica and silicates. It can contain also drying processing aids and/or rehydration agents as sorbitan monostearate, gums, carboxy-methyl-cellulose.

The said new frozen intermediate active dry yeasts according to the invention have the advantage to keep at least 6 months, preferably one year, their initial properties.

In other words the invention relates to new baker's yeasts according to the invention in the form of particles of frozen active dry yeast having an intermediate dry matter, i.e. a dry matter between 70% and 80%, preferably between 72% and 78%. Preferably the said new baker's yeasts according to the invention in the form of frozen active dry yeast are obtained or obtainable by a process comprising the use as starting strain of one of the strains belonging to the group of the strains CNCM I-2421 and I-2422 and of the similar strains to these two strains CNCM I-2421 and I-2422 and of the baker's yeast strains obtained by inactivation of the PAD1 gene(s). Still preferably the said process comprises a discontinuous inflow of molasses during the whole or part of the last cycle of multiplication. Still more preferably the new baker's yeasts according to the invention, in the form of frozen intermediate dry yeasts, have the hereabove defined gas releases in hereabove defined tests A<sub>1</sub>, A<sub>5</sub> and A<sub>6</sub>.

The invention also relates to a process for the preparation of baker's yeasts comprising the use as starting strain of one of the strains of the group comprising the strains deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the numbers I-2421 and I-2422.

The invention also relates to a process for the preparation of baker's yeasts comprising the use as starting strain of one of the strains selected from the group of the strains similar to the two strains I-2421 and I-2422 and the baker's yeast strains obtained by clean inactivation of the PAD1 gene(s).

Preferably in the said process, the strain chosen among the group comprising the strains I-2421 and I-2422 and the strains similar to the two strains I-2421 and I-2422 and the hereabove defined strains obtained by clean inactivation of the PAD1 gene(s) is cultivated according to a fed-batch process comprising a discontinuous inflow of molasses during the whole or part of the last cycle of cultivation, i.e. during the last hours before the yielding of the yeast cells in order to obtain commercial cream yeast, fresh compressed or crumbled yeast, active dry yeast, intermediate frozen active dry yeast.

In fact, on the one hand the process according to the invention for the preparation of new baker's yeasts according to the invention is firstly original, due to the use of a selected starting strain as hereabove disclosed, and on the other hand it can use the techniques conventionally used in the manufacture of baker's yeasts. However, preferably the said process uses a cultivation process comprising a discontinuous inflow of molasses.

Concerning any details relating to these techniques, reference is made to the manual "YEAST TECHNOLOGY", Reed and Peppler, The AVI PUBLISHING, 1973, or to the second edition of that manual by Reed and Nagodawithana, An AVI book published by VAN NOSTRAND REINHOLD, 1991, which are incorporated by reference or still preferably to the US patents 4,328,250, 4,396,632 and 5,741,695 and to the UK patent 1,539,211, and to the European patent No. 0 237 427 B2 or the Australian patent No. 609030, the entire disclosures of which are also incorporated by reference.

Indeed, the invention relates also to new baker's yeasts obtained or able to be obtained (= obtainable) according to the hereabove disclosed processes.

The invention relates finally to the use of baker's yeasts according to the invention for the manufacture of bread-making doughs aromatized (flavored) with cinnamon and/or for the manufacture of frozen dough pieces especially on the basis of sweetened doughs. Notably, it relates on the one hand to a process for the manufacture of breadmaking doughs aromatized with cinnamon, and on the other hand to a process for the manufacture of frozen dough pieces, preferably sweet frozen dough pieces, comprising the use of new baker's yeasts according to the invention. Preferably the invention relates to the said dough making processes comprising the use of a baker's yeast belonging to the group of the new baker's yeasts having good general performance in not delayed bread-makings, resistant with respect to the stress caused by freezing when they are used in sweetened doughs, and not giving rise to the appearance of off-flavors in the presence of cinnamon and of the new baker's yeasts obtained or obtainable by the process comprising the use as starting strain of one of the strains of the group comprising the strains CNCM I-2421 and I-2422, and the similar strains to these two strains, i.e. the strains sharing all the common properties to the said strains I-2421 and I-2422 and/or which are able to be selected as disclosed hereabove, and the baker's yeast strains

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## CLAIMS

### 1. New baker's yeasts which:

- have good general performances in not-delayed bread-makings, i.e. in bread-making processes which do not comprise a freezing or a deep-freezing step,
- are resistant with respect to the stress caused by freezing when they are used in sweetened doughs and
- do not give rise to the appearance neither of bad taste, nor of off-flavors in the presence of cinnamon.

### 2. New baker's yeasts according to claim 1, which:

- in not-delayed bread-makings, i.e. in bread-making processes which do not comprise a freezing or deep-freezing step, give rise in the fermentometer tests A<sub>1</sub>, A<sub>5</sub>, A<sub>6</sub> hereabove defined in the specification to results which are at least equivalent to those obtained with a control yeast produced conventionally starting from the strain CNCM I-2412,
- from the point of view of their resistance against the stress caused by freezing, permit obtaining doughs corresponding to the formulation of sweet Danish pastries, comprising 18% sugar by weight with respect to the flour, which after freezing during 100 days at - 20 °C and after thawing,
  - give rise to a total gas release measured with the zymotachygraphe CHOPIN® during 2 hours and 30 minutes at 27 °C, higher by at least 20 % preferably by at least 30 % and still more preferably by at least 40 % with respect to control doughs of the same formulation which were frozen and thawed under the same conditions and which were manufactured starting from a control yeast obtained conventionally starting from the strain CNCM I-2412,
  - give rise to a proof time measured at 35 °C lower by 10 % preferably by 15 % and still more preferably by 20 % with respect to the proof time obtained with the above-said control doughs.

### 3. New baker's yeasts according to claim 1 obtained by a process comprising the use as starting strain of the strain deposited according to the Budapest

Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the number I-2421.

5 4. New baker's yeasts according to claim 1 obtained by a process comprising the use as starting strain of the strain deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the number I-2422.

10 5. New baker's yeasts according to claim 1 obtained by a process comprising the use as starting strain of a strain selected from the group consisting of the strains similar to the strains deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the numbers I-2421 and I-2422.

15 6. New baker's yeasts according to claim 1 obtained by a process comprising the use as starting strain of a baker's yeast strain resistant to the stress caused by freezing and obtained by clean inactivation of the PAD1 gene(s) encoding phenylacrylic acid decarboxylase, a clean gene inactivation being a modification which cuts out the expression of the inactivated gene(s) without leading to the expression of a heterologous gene.

20 7. New baker's yeasts according to claim 1 obtained by a process comprising the cultivation of a selected starting strain according to a process comprising a discontinuous inflow of molasses during the whole or part of the last cycle of cultivation.

25 8. New baker's yeasts according to claim 1 obtained by a process comprising:  
- the use as starting strain of a strain selected from the group consisting of the strains deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the numbers I-2421 and I-2422, and the strains similar to the said two strains deposited under  
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the numbers I-2421 and I-2422, and the baker's yeast strains obtained by clean inactivation of the PAD1 gene(s),

- a discontinuous inflow of molasses during the whole or part of the last cycle of multiplication of the said selected strain.

5    **9.**    New baker's yeasts according to claim 1 wherein the said bakers yeasts are in the form of a frozen intermediate active dry yeast product having between 70 and 80 % dry matter, preferably between 72 and 78 % dry matter, and still more preferably between 74 and 78%.

10    **10.**    New baker's yeasts according to claim 1 wherein the said bakers yeast are in the form of a frozen intermediate active dry yeast product having between 70 and 80 % dry matter, preferably between 72 and 78 % dry matter, and giving the following gas releases in the tests A<sub>1</sub>, A<sub>5</sub>, A<sub>6</sub> hereabove defined in the specification:

test A<sub>1</sub> 170 ml to 190 ml in two hours

15    test A<sub>5</sub> 110 ml to 130 ml in two hours

test A<sub>6</sub> 115 ml to 140 ml in two hours.

20    **11.**    New baker's yeasts according to claim 1 obtainable by a process comprising the use as starting strain of a strain selected from the group consisting of the strains deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the numbers I-2421 and I-2422, and the strains similar to the said two strains deposited under the numbers I-2421 and I-2422, and the baker's yeast strains obtained by clean inactivation of the PAD1 gene(s), wherein the said bakers yeasts are in the form of a frozen intermediate active dry yeast product having between 70 and 25 80 % dry matter, preferably between 72 and 78 % dry matter, and giving the following gas releases in the tests A<sub>1</sub>, A<sub>5</sub>, A<sub>6</sub> hereabove defined in the specification:

test A<sub>1</sub> 170 ml to 190 ml in two hours

30    test A<sub>5</sub> 110 ml to 130 ml in two hours

test A<sub>6</sub> 115 ml to 140 ml in two hours.

**12.** New baker's yeasts in the form of particles of intermediate frozen active dry yeast having between 70% and 80% dry matter, preferably between 72 and 78%, which

- have good general performances in not-delayed bread-making i.e. in bread-making processes which do not comprise a freezing or a deep-freezing step,
- are resistant with respect to the stress caused by freezing when they are used in sweetened doughs and
- do not give rise to the appearance neither of bad taste, nor of off-flavors in the presence of cinnamon

and which give the following gaz releases in the test A<sub>1</sub>, A<sub>5</sub> and A<sub>6</sub> hereabove defined in the specification

test A<sub>1</sub> 170 ml to 190 ml in two hours

test A<sub>5</sub> 110 ml to 130 ml in two hours

test A<sub>6</sub> 115 ml to 140 ml in two hours

and which are obtainable by a process comprising:

- the use as starting strain of a strain selected from the group consisting of the strains deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the numbers I-2421 and I-2422, and the strains similar to the said two strains deposited under the numbers I-2421 and I-2422, and the baker's yeast strains obtained by clean inactivation of the PAD1 gene(s),
- a discontinuous inflow of molasses during the whole or part of the last cycle of multiplication of the said selected strain.

**13.** New baker's yeast strain deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, FRANCE, under the number I-2421.

**14.** New baker's yeast strain deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, FRANCE, under the number I-2422.



15. New baker's yeast strain obtained by clean inactivation of the PAD1 gene(s).
16. Process for the preparation of baker's yeasts comprising the use as starting strain of the strain deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the number I-2421.
17. . Process for the preparation of baker's yeasts comprising the use as starting strain of the strain deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the number I-2422.
18. Process for the preparation of baker's yeasts comprising the use as starting strain of one of the strains selected from the group of the strains similar to the two strains deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, Paris, under the numbers I-2421 and I-2422 and the baker's yeast strains obtained by clean inactivation of the PAD1 gene(s).
19. Process for the preparation of baker's yeasts according to one of claims 16, 17 and 18 wherein the said starting strain is cultivated according to a process comprising a discontinuous inflow of molasses during the whole or part of the last cycle of cultivation.
20. Process for the manufacture of bread-making doughs aromatized with cinnamon comprising the use of a new baker's yeast selected from the group consisting of the baker's yeasts having good general performance in not delayed bread-makings, resistant with respect to the stress caused by freezing when they are used in sweetened doughs, and not giving rise to the appearance of off-flavors in the presence of cinnamon or selected from the group consisting of the new baker's yeasts obtained by the process comprising the use as starting strain of one of the strains of the group comprising the strains deposited according the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the numbers I-2421 and I-2422, and the similar strains to the said strains I-2421 and I-2422, and the baker's yeast strains obtained by clean inactivation of the PAD1 gene(s).

21. Process for the manufacture of frozen sweetened doughs pieces comprising the use of a new baker's yeast selected from the group consisting of the baker's yeasts having good general performance in not delayed bread-makings and resistant with respect to the stress caused by freezing when they are used in sweetened doughs, and not giving rise to the appearance of off-flavors in the presence of cinnamon or selected from the group consisting of the new baker's yeasts obtained by the process comprising the use as starting strain of one of the strains of the group comprising the strains deposited according to the Budapest Convention with the "Collection Nationale de Cultures de Microorganismes", Institut Pasteur, 28 rue du Docteur Roux, 75724 PARIS CEDEX 15, under the numbers I-2421 and I-2422, and the similar strains to the said strains I-2421 and I-2422, and the baker's yeast strains obtained by the clean inactivation of the PAD1 gene(s).

22. Process for the production of breadmaking doughs according to one of claims 20 and 21 wherein the new baker's yeast used is in the form of a frozen intermediate dry yeast product.

ABSTRACT

New baker's yeasts which have good general performances in not-delayed bread-making, i.e., in bread-making processes which do not comprise a freezing or a deep-freezing step, are resistant with respect to the stress caused by freezing when they are used in sweetened doughs and do not give rise to the appearance neither of bad taste, nor of off-flavors in the presence of cinnamon.

Figure 1

